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Progress Report on Full Scale Fire Test in Japan

Osami Sugawa
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Many full scale fire tests have been carried out as Prof. K Kawagoe had encouraged the fire researchers to pursue the fire behavior through fire tests which simulate a real fire. On 5th March 1996, about one week ago of this meeting, a full scale fire test was done in BRI using a wooden 3 story building with two 2 story wooden houses which were set in downwind of fire spreading course. Many researchers and students joined and supported to the full scale fire test. This experimental research was planned by Dr. Y. Hasemi, his colleagues, and members of BRI to observe whether this building can suppress the fire spreading velocity in case of such building locates in a city fire. Kobe City fire, occurred after the earthquake of 17th January 1995, was uppermost in everyone's mind.

Followings are the titles and author(s) who carried out full scale and semi-full scale fire test(s) which includes full scale test pieces.



1995

An Experimental Study of Early Warning Fire Detector System in Telecommunications Equipment Rooms, Part I - Conventional Smoke Sensors Characteristics in a Testing Chamber, and Part II - Smoke Movement in a Full Scale Testing Room, by Noda et. al , [JAFSE Annual Meeting,

pp62-69]

They carried out two series of the tests; chamber test to characterize the conventional smoke sensors, and full scale test to observe smoke movement in a model room for a telecommunications equipment. In the first test, they used PVC cables, fire retarded polyethylene cables, epoxy boards with electric parts, paper, and wood for fuel. High precision smoke detector (ASSD) connected with air sampling tube lines, HCL sensor, smoke detectors (light scattering and ionization type) were set in the return space of the chamber (2.4m x 2.4m x 2.4m(H)) with upwind air conditioned at the 45 times/h air exchange rate. In the detectors and sensors, ASSD showed earliest detection with and without air ventilation, and the little difference in detecting times between these ventilation conditions. Smoke detectors (light scattering and ionization type) showed delay in detecting time but HCL sensor showed earlier when ventilation was given to the chamber. The second test was carried out using a full scale equipment room of 14.4m x 36m x 2.8m(H) with 1.75m of the return ceiling chamber and 0.45m air supply floor chamber (free access floor type). Ten sets of ASSDs were used to monitor the early smoke detection system for a smoldering fire changing the ventilation rates.

A System for the Evaluation of the Intelligibility of Outdoor Speaker System, [JAFSE Annual Meeting, pp.116-119] by Y. Matsubara, and M. Inagaki (Fire Research Institute)

A Study on toward light, when human select a evacuation passage - Verification of evacuation drill at office building, [JAFSE Annual Meeting, pp.132-135] by K. Kubota (Fujita Corporation), and Y. Murosaki (Kobe Univ.)

Walking Speeds of People in Refuge, Part II, [JAFSE Annual Meeting, pp.140-143] by Y. Ohshima, M. Watanabe (Bunka Shutter), M. Nara (Sci. Univ. of Tokyo)

Study on People Movement under High Density - Doorway and Stair - Part II, [JAFSE Annual Meeting, pp.144-147] by T. Uetake, M. Watanabe (Bunka Shutter), M. Nara (Sci. Univ. of Tokyo)

Study on Refugee Density in case of Escape in a Building, Part II, [JAFSE Annual Meeting, pp.148-151] by T. Kumagai, M. Watanabe (Bunka Shutter), M. Nara (Sci. Univ. of Tokyo)

Evaluation on Smoke and Gases Using Full Scale Fire Test, , [JAFSE Annual Meeting, pp.172-175] by K. Yoshida, and S. Nagasawa (Research Institute of Marine Engineering)

Experimental Study on Full Scale Fire Tests in Atrium Space, , [JAFSE Annual Meeting, pp.176-179] by H. Kuwana, H. Satoh, H. Kurioka (Kajima Technical Research Institute), and O. Sugawa (Sci. Univ. of Tokyo)

Ignition Mechanism of Fuel leaked in Vehicles, , [JAFSE Annual Meeting, pp.220-223] by T. Takahashi, M. Sugisaki, T. Sada, and T. Tsurumi

Ignition Process of Intermittent Short-circuit on the Modeled Automobile Wires, , [JAFSE Annual Meeting, pp.224-227] by Y. Tamura and J. Suzuki (Japan Automobile Research Institute)



1994

Flow Characterization of Smoke and CO gas, [JAFSE Annual Meeting, pp.248-251] by D. Kouzeki, et. al (Fire Research Institute), and S. Kusanagi et. al (Matsushita Electric Works, Ltd.),

Flow and diffusion behavior of smoke and CO gas was measured using a model step shaft (19m high, 4.5m x 4 steps with 1.3m wide) connected with a corridor at the ground level. Smoke detectors, heat detectors, and CO gas sensors were mounted under each ceiling. Cotton wick, beech wood, polyurethane foam, news paper were used as fuel simulating smoldering and flaming fire.

Analysis of Heat of Fire by Color TV Camera, [JAFSE Annual Meeting, pp.20-21] by Y. Fujiwara, T. Ono, and H. Ishii (Nihon University)

Study of Fire Detection in Air Conditioned Rooms, [JAFSE Annual Meeting, pp.30-33] by K. Satoh (Fire Research Institute)

Heat Release Characteristics of Combustible Loads/Linings in Train Vehicles, [JAFSE Annual Meeting, pp.104-107] by Y. Hasemi (Building Research Institute), R. Kikuchi (Sci. Univ. of Tokyo), and M. Yoshida (Building Research Institute)

Grasping the Actual Condition of Occupant in a Building and Defining Standard Figures, [JAFSE Annual Meeting, pp.220-223] by Y. Murosaki (Kobe University), and M. Nakano (Konoike Construction Co., Ltd.)

In Site Tests of a Air Sampling Smoke Detection in Telecommunications, [AIJ Annual Meeting, No. 3003, 3004] by S. Noda and M. Ichimura (NTT Power and Build. Facilities Inc.)

Survey and Analysis on Surface Area of Fire Load, [AIJ Annual Meeting, No. 3016] by K. Aburano et. al. (Sci. Univ. of Tokyo)

A Study on Fire Resistance for the Partitioning Wall and so on by Wood Frame Construction, [AIJ Annual Meeting, No. 3046] by M. Takada et. al (Japan Housing & Wood Tech Center, Foundation)

Experimental Study on Fire Wall with Fire-Resistant Glass, [AIJ Annual Meeting, No. 3048] by K. Kubota and I. Takahashi

Fire Safety Design of Tall and Narrow Atrium, [AIJ Annual Meeting, No. 3064, 3065, 3066] Part 4, Plume Behavior and Analytical Model by O. Sugawa et. al (Sci. Univ. of Tokyo) Part 5, Full Scale Test of Atrium Space by H. Kuwana et. al (Kajima Tech. Res. Inst.) Part 6, Propriety of Simplified Model to Full Scale Test by H. Kurioka et. al (Kajima Tech. Res. Inst.)

A Demonstration Test of the Pressurizing Smoke Control System via an Atrium and Shaft, [AIJ Annual Meeting, No. 3070] by M. Hirota (Inst. of Tech., Shimizu Corporation)

Pressurization Smoke Control System, [AIJ Annual Meeting, No. 3072, 3073] Part I - Full Scale Test of Exterior Wall-through Type Pressurization System by A. Nohara et. al (Res. and Devlp. Inst., Takenaka Corp.) Part II - Smoke Movement in Office Space at Initial Fire Stage by T. Nagaoka et. al (Res. and Dev. Inst., Takenaka Corp.)

Experiments on Stair Lobbies Pressurization for Smoke Control with Air Supply Duct, [AIJ Annual Meeting, No.3074] by I. Takahashi, T. Hara, S. Yamamoto, and I. Kasahara (Mech. Elect. Eng. Design Div., Taisei Corp.)

Effect of Architectural Factors on Wayfinding in an Emergency, [AIJ Annual Meeting, No.3085] by H. Hayashi, Y. Murosaki, and T. Nishigaki (Kobe University)

A Verification on the Presumption of Evacuation, Fire and Smoke Behavior using Survivors' Evidence at the Time of Fire, [AIJ Annual Meeting, No.3087] by K. Kawamura, S. Nemoto and S. Okishio (Sci. Univ. of Tokyo)



1993

Reverse Stratified Flow of smoke and Gases in Tunnel-like Underground Fires, [JAFSE Annual Meeting, pp.58-61] by T. Komai, N. Shikada, M. Tanaka, and Y. Nakagawa (Natl. Inst. of Resource and Environment)

Experimental Study on Smoke Control Method Considering the Influence of Opening Condition for Smoke Movement, [JAFSE Annual Meeting, pp.90-93] by K. Kojima and S. Hashimoto and K. Okajima (Hazama Research Institute)

A Study on Smoke Flow in a Galleried Large Scale Void, [JAFSE Annual Meeting, pp.94-101] Part I - An Experimental Study of the Smoke Flow in a Full Scale Gallery, by T. Nagaoka, A. Kodaira, and S. Uehara (Takenaka Komuten Res. Inst.) Part II - Consideration on Smoke Behavior by Simulation and Test by S. Uehara, A. Kodaira, and T. Nagaoka (Takenaka Komuten Res. Inst.)

Full scale test was carried out on smoke movement in a galleried Void of 41m high, 16m wide, and 193m long. Triangular roof of polycarbonate was put on the top and of which base periphery had 2m high opening (540m² in total opening area) for natural ventilation. Model fire source of methanol (16 pans of 50cmx50cm square) was set at the center of the void gave 1.54MW for 5min. Flow visualization was carried out using smoke candles. Temperatures distribution for vertical and horizontal directions, and smoke depth were measured. Some of the detailed results including 3D simulation was presented in 12th UJNR Mini-Symposium.

Study of Behavior of Fire Gas in Air Conditioned Flow [JAFSE Annual Meeting, pp.102-105] by K. Satoh (Fire Research Institute) He made a model compartment fire with air conditioned using a compartment of 4.45m x 4.45m x 2.45m(H) and 3D computer simulation was done using UNDFRI code. Calculated results for smoldering fire of cotton wicks were compared with measured ones .

Measurements of the Shaft Pressure Variation caused by the Movements of Elevator Cars by K. Harada, T. Terai, and Y. Zhi Jun (Kyoto University) [JAFSE, Annual Meeting, pp106-109]

In order to establish the pressurized smoke control, Harada et. al carried out the measurements of differential pressure between shaft and floor changing the elevator velocity (150m/min, 120m/min, and 80m/min), number of elevator cars, and operation schedule of 6 cars. They estimate the pressure difference shaft and floor based on ventilation network. Models proposed by Matsushita and Klote were used and good agreement was obtained between the estimation and measured ones.

Experimental Study on Elevator Evacuation in a Fire Emergency by K.Muraoka and Y. Miyagawa (Res. Ins. Ohbayashi Corp.) [AIJ, Annual Meeting, pp106-109]

A Study on the Limitation of Building Height to apply a Pressurizing Smoke Control System Based on Pressure Difference between Escape Route on a Fire-Floor and Shaft, [AIJ Annual Meeting, No. 3025] by M. Hirota (Inst. of Tech., Shimizu Corp.)

An Experimental Study on Direction Judgment of Travelers in Emergency in Urban Underground Environment, [AIJ Annual Meeting, No. 3043, 3044] Part I - by M. Ohkura (Seikei Univ.) et. al Part II - by M. Oiri (Labor Sci. Inst.) et. al

Fundamental Study on Pedestrian Crowd Flow for a Simulation Method for Fire Escape Planning, [AIJ Annual Meeting, No. 3045, 3046] Part I - Outline of Simulation Model Regarding Pedestrian Crowd Flow by T. Higashiguchi (Toda Corp.), et. al Part II - Comparison with Actual Measurement by H. Nigorikawa (Nagano Corp.) et. al

They measured the human movement velocity at the door ways when the meeting was held in Matsumoto Theater of which has three different capacity of 608, 1311, and 1352 seats. Effluent velocity of persons measured at door was 0.52 - 1.28 persons/msec and which was smaller than 1.5 persons/msec used for fire safety design. They also simulated the time needed for escape based on human density and path width as Dr. Togawa had proposed.

Development of Hybrid Robot System to assist Firefighting in a High Building, [AIJ Annual Meeting, No. 3089, 3090, 3091, 3092] Part I - Basic Specifications by H. Hoshino et. al (Takenaka Corp.) Part II - Basic Design by Y. Takada et. al (Komatsu Corp.) Part III - Demonstration by O.Hukutomi (Nippon Biso Corp.), Part IV - Evaluation by T. Hayakawa (Takenaka Corp.)

They designed a robot based on a gondola which is lifted by a crane mounted on a roof of a high-rise building. This robot can move along a wall vertically and horizontally to find a fire compartment utilizing TV camera eyes, and IR detector. The robot has extinguishing chemical agent, and drill unit. In the case of the robot find and detect a hot zone (fire zone) in a compartment through a window, it makes a hole by a drill unit to inject the extinguishing chemical agent. It can move 30m/min for horizontal direction and climb up 40m/min having an operator. They demonstrated an evacuation using a full size robot but no model fire was given to the test.

JAFSE: Japanese Association on Fire Safety Engineering
AIJH: Architectural Institute of Japan